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REPORT OF STUDY COMMITTEE NO. 1

Willard F. Libby, *Chairman;* John R. Whinnery, *Vice-Chairman;* J. Ralph Audy, Madison S. Beeler, Homer D. Chapman, Thomas S. Kuhn, Henry W. Menard, Jr., Ralph H. Turner, David H. Volman

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THE RESEARCH ROLE OF THE UNIVERSITY

The objectives of the University of California are teaching and research.[1] In addition, public service springs from these activities. The unique characteristic of a great university is that these functions interact on each other to produce an effect that is more creative and important than if the three were isolated. The student benefits intellectually and develops curiosity through association with a faculty engaged in creative activity. The faculty in turn is intellectually challenged and developed by research activity and the stimulus of explaining to young and fresh minds. Joint acquisition of knowledge by students and faculty is what characterizes a university. The service function, besides being an obligation as a part of the dissemination of knowledge, brings to faculty and students the stimulation of applying knowledge to the problems of modern life.

Thus, the fruits of the university are trained students with inquiring minds who carry over into society fresh and exciting points of view, and the advancement of knowledge with the original ideas of scholars produced in an atmosphere where creation and communication combine in a joint venture.

This concept of a university has not always existed, but has evolved, most notably during the last century.[2]

For the purposes of this study we may consider research as any activity that increases or deepens our knowledge and understanding of any field, or, in the arts, creates new and significant symbols.[3] The general value of research in a university environment is noted above. To establish a base on which to build all discussions of this conference, however, we can set down at least the four following specific reasons for research in a university:

1. The university as a community of creative scholars has an obligation to contribute to the growth of knowledge in general.

2. There is a more specific obligation to help solve problems of the community, state, or nation when unique talents of its faculty or special facilities are needed for such problems.

3. A faculty member continuously active in research will be more likely to remain an effective and stimulating teacher than one who is not contributing to the growth of a field.

4. A distinguished faculty, of the type necessary for the stimulation of creative thinking, can be attracted only by environment that encourages effective research.[4]

Research as defined covers a whole spectrum of activities in the different fields, from the most straightforward of studies following the ideal scientific method of data collection, hypothesis building, and

[1] "Preliminary Draft of an Academic Plan for the University of California" (June 19, 1959).

[2] C. A. Elvehjem, *Basic Research and the State University;* Symposium on Basic Research, Publication No. 56 of AAAS, Washington, D.C., 1959.

[3] Adapted from the definition given in *Proceedings of the Ninth All-University Conference,* p. 28.

[4] See Point 3 on Recruiting, p. 30 of "Preliminary Draft of an Academic Plan for the University of California."

hypothesis checking, to the creativity of the fine arts. In all of these fields the purposes of research are largely those set forth above (recognizing that some fields more than others will be subject to demands for research for the community or government). The problems are often quite different, however, and some of the different problems are discussed in Part IV of this study.

Research is frequently divided into "basic" (fundamental) research and "applied" research. The goal of the first is to enrich man's life by increasing his understanding of himself and of nature, and by opening new vistas of interest and activity. That of the second is to increase man's control over his environment and himself. In one sense, the difference is largely one of motives, for new knowledge may result whether the goal is the first or the second. It is also true that basic research is eminently practical, for examples can be given without limit where research done only for understanding has had tremendous and far-reaching effects on our civilization. Perhaps the danger is that basic research is too often justified on the basis of such examples so that one begins too early in each investigation to look for the fruits. While that justification is spectacularly true in the large, it should be remembered that man is by nature an inquiring, value-creating animal to whom the pursuit of understanding is often more important than practical control, and this should remain the primary justification for basic research in a university. The "Preliminary Draft of an Academic Plan for the University of California," while recognizing the importance of applied research and the diffuse lines between basic and applied work, says that "the University should put major emphasis on basic research. . . ."[5]

I

The Restricted Locus of Academic Research

What has been said so far implies that the best teaching and the vital contributions to national health and welfare are likely to come from colleges and universities whose faculties engage continually and actively in research. Both the increase of knowledge and the production of men able to increase it depend on the continued vitality of just such institutions. Yet it would be utopian to hope that in any country like our own—a country committed both by tradition and conviction to supplying higher education to a large portion of its citizens—all higher education can be carried on within institutions that combine major research with teaching. The conditions that have restricted the locus of most academic research to a small percentage of America's colleges and universities (and principally to the latter) are very strong and likely to grow stronger.

Some of those conditions derive from a need for special equipment, much of it extremely expensive. That is most obviously true in the natural sciences, with their laboratories and herbaria, accelerators, and computing machines. Computers as well as laboratory and field research are, however, increasingly the perquisites of the social sciences also, and in those fields, as in the humanities, where special instruments are rarely needed, access to a major library, usually one with several million volumes, is indispensable to productive research.

The principal pressures leading to localization of the research activity derive, however, not from shortage of equipment but from shortage of personnel. Even if—as is far from being desirable and even further from being the case—all of the men potentially capable of first-rate academic research were at work in American colleges and universities, they would constitute only a small proportion of those institutions' staffs. It is not even clear that they would provide a sufficiently significant fraction to keep research alive, for that activity clearly thrives best in an institution where much research is already going on. Anyone who has followed the careers of his able graduate students for a number of years will have observed the great decrease, often the complete stoppage, of

[5] *Ibid.*, p. 3.

their research activities when isolated in institutions where such activity is the rare exception. With an expanding market for men of research potential, this stoppage will fortunately but rarely occur. It would be inevitable, however, if available talent were scattered over the entire American system of higher education. To continue at a high level, academic research must be concentrated in a relatively small proportion of America's institutions of higher learning.

Because students vary in their needs and demands as greatly as does the faculty, the need to restrict the locus of academic research is no cause for alarm. It is in postgraduate education that a research-oriented faculty is essential. Vocational training might occasionally profit from, but surely not demand, such a faculty. Nor is such a faculty essential to the four-year liberal arts college, a uniquely American institution that presents a principal clue to this country's success in providing higher education for the many while preserving, mainly in universities, the function of academic research. The existence of such colleges preserves the university and simultaneously presents it with a constant challenge. That university faculties worry as much as they do about the impersonality of the large lecture course or about the lack of student-faculty contact is largely due to their consciousness of another model for higher education.

II

The University's Function as Distinguished from That of Nonacademic Research Institutions

From the preceding, it is clear that the distinction in research between a university and a nonacademic institution is twofold. The first difference is due to the presence of students and the teaching function, and the effect on new ideas of the stimulation of young minds. The second is that shielding is greater against pressures for short-range accomplishments than in most institutions with more specific research goals.

Before developing either of the above differences in detail, it is desirable to examine the types of research institutions that exist, and particularly their rapid growth in the last few years. This growth has followed and in many respects paralleled that in universities, and has come about because of the spectacular success of basic research ideas in affecting practical matters of our civilization. The types of nonacademic institutions of concern here are largely the industrial research laboratories, the research organizations of our government, and the nonprofit research institutes that depend for support upon charges from research results, gifts, or endowments. In all but the last of these classes the eventual results desired are usually fairly practical.

An industrial research laboratory is interested in improving its product, reducing costs, and developing new products. The government laboratory usually has a specific assignment—whether defense, as in the Naval Research Laboratory, or measurement, as in the Bureau of Standards. The research institute that must sell its services for support must also pay attention to the ultimate practicality of its results. Only in separately supported institutes, such as the Institute for Advanced Study in Princeton or the Center for Advanced Study in the Behavioral Sciences in Stanford, does support allow the organization to be shielded from pressure for short-range practical results in a manner like that in a university. The management of the great laboratories of the first three classes may, however, take a very long-range view and recognize that new ideas are the most practical things in the end, even if the application is not clear at the beginning. Thus, some first-class basic research is done in the industrial laboratories, but even the wisest of these are unable to prevent ultimate goals from exercising some constraint on the research process. Such constraint is usually felt in the selection of the field for research. But even freedom of selection of field is important. Many new areas of research have originated in universities without any fore-

knowledge that they were related to a practical problem, though they were turned over to industrial laboratories when the practical importance became apparent.

The advantage of the nonacademic research laboratory is that the researchers have full time for research, and usually have better salaries and facilities. Discussion of these points as handicaps to the research function of the university is a matter for Study Committee No. 3. The advantages of the university already noted are that the teaching function can help the research process and that freedom to choose research problems is greater. That these are real and not theoretical has been verified by the number of faculty members who have come to the University from the excellent research organizations cited, stating that one or both of these advantages were the prime reason for the move. It may be noted parenthetically that these advantages have not escaped the notice of the management of dynamic industrial organizations, and many of these are trying to provide what is described as an "academic" or "university" atmosphere in their laboratories. This expresses itself sometimes only in a "campus-like" atmosphere of grounds and buildings, but often also in increased freedom of choice in the selection of areas of work. Stimulation of the teaching function has been attempted in many institutions by internal training programs, or association with near-by universities, as in the Bell Laboratories–New York University graduate program, but this part of the program so far remains the least successful.

In comparing the two types of institutions, there should be implied no competition (except a friendly one), but rather cooperation. Nevertheless, the university should remember its basic differences, developing its own advantages for its purpose, and not succumb to short-range pressures or develop too many constraints of its own. Unfortunately, there are such constraints. Most of these properly belong in the subject of Study Committee No. 3, but one is so basic and important that it must be mentioned here. It is the constraint placed by our own system of evaluation and promotions, which does have many advantages but requires a man to start showing a sizable volume of productive results within at least two years of arrival if he is to be ensured an orderly progress up our promotion ladder. That does tend to channel thought into "safe" channels where results are assured. It hardly offers a man the luxury of speculating in an area that may come to nothing in the end, which is one of the possibilities in truly free research investigations.

III
Teaching and Research: The Problem of Balance

Because teaching and research can each be carried on without the other, a university faces a special problem that has little parallel in other educational or research institutions. How are the two functions to be kept in balance? To say that teaching and research can and must fertilize each other, particularly at the graduate level, is not to say that they may not also in practice conflict. Both research and teaching demand much time, energy, and single-minded devotion, and these are not commodities in unlimited supply. The competing demands for these scarce resources can become overwhelming, particularly at the University of California, where the preservation of faculty self-government imposes an unprecedented amount of administrative committee work on many members of the faculty.

On several campuses of the University there has recently been much evidence of increasing and quite justified concern with the shortcomings of university education, particularly at the undergraduate level. The result has been a growing search for ways of recognizing and rewarding the able teacher. In particular, administrative directives have increasingly urged that departments carefully evaluate the teaching performance of candidates for promotion and that promotion committees give full weight to these evaluations. Our Committee feels certain that this new emphasis on

a long-standing University policy is directed to a real problem. Nevertheless, in the face of persistent suggestions that the University meet the coming shortage of staff by permitting teaching excellence to compensate for research deficiency when granting faculty appointments and promotions, we are impelled to affirm our conviction that, in a university, research excellence must continue to be considered strongly in faculty appointments and promotions.

One reason for this conviction is the intrinsic difficulty of evaluating teaching excellence. Course enrollment and student popularity are at best unreliable measures, and often consistently misleading. Occasional faculty visitation at a candidate's lectures may leave an impression quite different from that gained by regular participation, including participation in course assignments and examinations. But even if teaching could be reliably evaluated—and our attempts in this direction must not be diminished—research would still be the more important criterion in a university. Whatever the administrative regulations, a faculty member's status among his university colleagues will inevitably derive principally from his professional performances. Under these circumstances, a man who brings *only* talent and enthusiasm for teaching with him from graduate school may well be seen as a second-rate member of the local academic community. If he is, the danger is real that, within a decade of his promotion to tenure, he will prove to be a very routine teacher indeed. Not only within the faculty as a whole but also for the individual faculty member, the balance betweeen teaching and research must be preserved.

In discussing the problem of balancing the multiple responsibilities of university faculty members we have said nothing about faculty services to the nation and the local community. But that is only because this is the area in which we find least need for vigilance or for recommendations. This University's great faculty necessarily includes many men whose special talents and training make them a vital natural resource, and the University has a public responsibility to release their time when they are vitally needed and to treat some part of their service to the public as a service to the University itself. Clearly, that is already being done. The only problem we have found in this area is a possible need of official reaffirmation of the obvious. If public service is to be considered university service as well, then it must lie in an area for which the faculty member's talents and training especially equip him. Reports of "service" on promotion committee dossiers are not always of this sort.

IV

Differences in Research from Field to Field

To this point the word "research" has usually been used as though it were synonymous with "creative activity." This report may, therefore, seem to have implied that the creative products typical of a great university faculty are all of a piece. But that is true only in the most general way. For example, to merit approval and reward, the creative work of a faculty member must be original in a double sense: it must be new, and it must be a serious attempt to alter the direction of future creative expression in its field. Or again, the prerequisites for creative faculty research include a measure of freedom from external pressures and a considerable freedom from irrelevant distraction. We think these are not trivial conclusions, but at this level of generality they lead to only the most hortatory recommendations. If recommendations are to take a more concrete form, it is first essential to realize how much the nature of the research and creative process differs from department to department and from field to field. In different fields, research productivity demands different sorts of support. The point needs emphasis because today, both in the nation and in the University, some sorts of support are far easier to obtain than others. Policies that are apparently uniform have very different results in different fields. For example, there is a problem

in that to the extent that the University maintains professional schools, these must by definition be largely concerned with applied research. To such schools the research is not of secondary importance if they, too, are to be of first quality. The answer is that it must also be creative in enlarging the boundaries of knowledge in the applied field, and must be concerned with longer-range goals and more exploratory work than are possible outside of the university atmosphere.

Prime differences in research in different fields, in addition to those mentioned, are primarily the degree of recognition of the need for the usefulness of mechanical equipment and apparatus, of corps of specially trained technicians, and of the technique of using a group of investigators on a single research problem. The natural sciences have come to be relatively well supplied with experimental equipment—all the way from enormous telescopes, accelerators, computing machines, and electron microscopes, to elegantly efficient small laboratory tools, such as the gas chromatograph, that operates smoothly and reliably in the hands of relatively untrained technicians to accomplish fantastically difficult tasks. In other fields, the difficulty lies partly in less general recognition of the need for equipment and partly in reluctance to demand it. It is commonly thought that the natural sciences acquired these marvelous mechanical aids because they have ample funds. That is true only in part. The demand had to come first, then the inventions had to be made, and finally the money for general supply became necessary. It is possible that Ernest Orlando Lawrence would have invented the cyclotron even if he thought it would not be widely used, but those who knew him doubt it strongly. His motive was to open up the field of nuclear physics and not just to invent a marvelous electrical tool. Researchers in other fields are vitally aware of how their investigations could benefit similarly from more mechanical aids and sufficient permanent technical personnel trained in their operation. Already we see the impact on the social sciences of computing machines, group observation laboratories, and various kinds of recording equipment, and it is likely that this is the forerunner of further similar developments. What, for instance, would a good, cheap machine translator do to the language barrier?

In the behavioral sciences, a staff of technically trained persons is one of the most important research tools. Indispensable when interviews provide the principal data are a sample of sufficient size and representativeness and the conduct of the interviews by personnel experienced in establishing rapport and avoiding bias. The frequent procedure of hastily training a new set of interviewers and other personnel for each investigation is wasteful and damaging to the quality of research. Only when a permanent corps of experienced interviewers and other technical personnel is maintained for use as needed in individual investigations can high quality and efficiency be attained. Such permanent research staffs are not now generally available, though they would be useful to most of the social sciences and to some of the natural sciences.

Finally, the technique of group research —massive attack on a research problem by a group of investigators working together —has been very largely restricted to the natural sciences in its application. It is obvious, however, that there are several other areas in which it should be very fruitful. The suggestion is not original, and in fact it has been so widely advocated that the pressure to adopt it has occasionally assumed the proportions of a *mystique*. The obvious suitability of group research to some parts of the natural sciences, and the fact that it is relatively easier to get a large foundation grant for many people than to get a small grant for one, have been strong talking points. One must be extremely careful, however, to ensure that the specific problem fits the technique, because it seems that in general the significant contributions of the future are most likely to come from the gifted individual, free to work in isolation until his results have fully matured. At the same time, how-

ever, some fields now investigated solely by individuals might profit occasionally from a group attack.

V

The Role of Non-Faculty Research Personnel

The matter of non-faculty research personnel is closely related to the problem of group versus individual research. In fields where the size of equipment or complexity of problems requires the group approach, a certain number of permanent research employees may be necessary to make full use of the equipment, or to provide a significant attack on the problem. In the general case, however, such personnel should be looked on as simply a supplement to the faculty research function, should be kept within limits, and should not be allowed to grow as an end in itself. That is because the special function of research in a university has been taken here to be its interplay with the teaching function, and so the two must obviously be kept in proper proportions for effective results.

In some cases, the purely service obligation to an important state or national issue may require the building up of an organization larger than would seem optimum under the above criteria. In such cases, the organization should provide enough insulation that the resulting institute will not dominate or destroy the related academic function, but will at the same time provide stimulation to the academic department by virtue of the research activity possible. The relations between the Department of Physics and the Lawrence Radiation Laboratory at Berkeley would seem to be a good example of such organization.

The classifications and rights of research personnel should largely parallel those of the faculty personnel, although a continuing and sensitive evaluation of the relative advantages of the respective positions should be carried out. There is a tendency for non-faculty appointees to consider themselves as second-class citizens to some degree, if only because they are not members of the Academic Senate, and such membership is usually not appropriate unless the individuals take some part in the teaching function. It is also to be noted that some universities that have removed all restrictions between the purely research and normal faculty appointments have found the research appointments to be the most desirable because of the opportunity to devote full time to research in a university atmosphere.

So far as the Committee knows, the present balance between privileges in this University is working reasonably well with one possible exception. It has been pointed out that on campuses such as Riverside and La Jolla, which have been converted from research campuses to general campuses, there is a transient problem as incoming Academic Senate members adopt rules that affect in some measure the original settlers. Since this is quite a special problem, it probably suffices to point it out as something that needs attention in such cases.

VI

Responsibilities of the University to Agriculture, Industry, Government, and Society

President Emeritus Sproul, in his opening of the Second All-University Conference, pointed out that no university or college "floats in a vacuum," but that each "is conditioned by its constituency, and by the temper of the times." The University of California, as a state university, must particularly remember its obligations to its constituency, the citizens of the State of California. This University was created by the State to fulfill its needs in agriculture, mining, industry, and other pursuits of the citizenry. Fortunately the constituency has interpreted this obligation in the broadest and wisest terms, recognizing that the training and stimulation of good minds will serve the State best in the end, that basic research ideas for which the application is not at first obvious may have the greatest eventual impact on the welfare of the State, and that an international

student body and a faculty taking part in international scholarship and helping to fulfill our obligation as citizens of the world, will contribute to the State by bringing in new ideas.

The above-stated broad objective is the correct and most important one in the large, but we must not forget the obligation to contribute in more specific terms where needed. That was the point of the second research objective stated in Part I of this study. The example of agriculture is a very good one in which an important industry of the State, with no central research organization of its own, has come to know very clearly and in very specific terms the importance of the University to its citizens. There are many problems of government and society where the special knowledge and abilities of our staff create a real obligation to help in an immediate problem, or indicate a longer-term line of research with definite applied goals. There are similar parallels with respect to industries of the State, although there the University should be especially careful to undertake investigations that help the industry as a whole rather than one company in an industry, and it should not undertake purely service functions for which private facilities are available.

It is inevitable that the responsibilities for taking part in immediate problems will fall more heavily on some departments of the University than on others. The danger in such cases is that short-term goals will predominate, with all the dangers noted earlier, and that the more important long-term goals will suffer—in the end to the detriment of the State. On the other hand, real needs can stimulate thinking toward basic ideas if the work is properly organized. It is the responsibility of these departments as well as of the whole University to see that both objectives are so carried out that the two functions complement rather than destroy one another. Because of the importance to the State that its University remain great, and the present special importance of public support for the University, the successful working out of this complementary relationship of research goals is one of the most important and challenging problems now facing us.

The University must keep the public informed of the results of its research. That has been well done in the past, and similar efforts should be encouraged in the future. The faculty will have ideas of ways in which this important task can be accomplished. The faculty must be assiduously protected, however, against the danger that time and energy may be diverted from research itself for the sake of public information.

VII

Conclusions and Recommendations

1. The policy of the University should be to do research for the advance of human knowledge and to teach. These two functions are compatible, and necessary to each other. Potential ability as a teacher must play a significant role in the making of appointments and in promotions, but scholarly and creative acivities must come first in the selection of faculty members.

The University must be at the very forefront of knowledge, and therefore must be a source of that knowledge. The interrelation of various fields is so extensive that only in the university environment can full advantage be taken of a discovery in one field that has applications in others. That can be done most readily and quickly in the university environment and can lead to group attack, which is not possible in any other type of research institution.

There are important differences in the nature of research from field to field, and the sciences in particular are moving very much more rapidly than the humanities, yet the essential character of research effort is the same in all fields. The purposes and nature of university research are to stimulate students, promote and catalyze good teaching, and advance human knowledge. All kinds of research activities are appropriate to the university.

2. The University should be a national power. It should be so conversant, and its faculty members so well informed, in the various fields of human knowledge, that

they may at any time profitably be called by the Government for advice.

3. The University's responsibilities include producing graduates trained in the various fields.

4. The University should have no particular policy about research except that it all be of excellent quality. There should be minimum restriction of a given type of research to a given campus or a given department. On the other hand, if a strong productive effort in a given field of research is developing, it should be encouraged—the thought being that two or three people interested in the same subject are more than two or three times as effective as one alone.

5. Non-faculty research personnel perform important functions in the University. There should be a means of requiring excellence of performance on the part of these people, and the Chief Campus Officer should develop appropriate methods to accomplish this end.

6. The University should have a national outlook in its support of research and see that its efforts are substantial and commensurate with those of other leading universities in the country.

7. The University must make all reasonable efforts to keep the public informed of the results of its research, and the good efforts toward that end in past years should be augmented. The faculty itself should have useful suggestions for improving this important service.

8. The University should serve the community as a source of advice that it is peculiarly equipped to give on the forefront of knowledge in the research area. Its greatest general service, of course, will always be the training of its students.

Summary of Discussion

Recording Secretaries: **Wendell Bell, Russell D. Coleman**

A considerable amount of discussion concerned the proper relation between the teaching and research functions of the University. It was the consensus of the Conference that both have been and continue to be essential functions, and that teaching of the quality required by the University cannot be separated from research. The acquisition of new knowledge through research must be disseminated by teaching that unequivocally complements research. Research in many of its facets not only is essential to teaching, but is in itself often a form of teaching.

Research as very broadly construed by this Conference has different connotations in the various fields of learning. It includes scholarly and artistic activities in the humanities, as well as scientific investigations. These different kinds of creative effort stand in a variety of specific relations to teaching and public service.

There was general agreement that research accomplishment in this broad sense provides the most tangible estimate of continued professional growth in the selection and promotion of faculty members. However, the difficulty of accurately measuring teaching ability does not imply that teaching is of secondary importance.

It was repeatedly asserted that more recognition should be given to non-faculty research personnel. While they enjoy certain advantages which many faculty members do not possess (namely, the eleven-month salary scale and more time to pursue their research), nevertheless several participants felt that many non-faculty research personnel, particularly those whose support comes from the State, should be extended Academic Senate membership and academic titles.

It was suggested that the locus of major academic research is necessarily restricted to universities whose faculties continually engage in research. On the other hand, it was felt that graduate students who upon graduation serve in smaller institutions

should be encouraged to continue their research, even though it might have to be on a smaller scale.

There was considerable discussion of faculty work-load standards that take account of the several functions of teaching, research, and public service. Better measurement of faculty performance and activity also was called for in order to help the University present a more accurate picture of itself to interested publics. It was pointed out that people not acquainted with the multiple functions of the University tend to think only of its formal classroom activities, rather than of the total of teaching, research, and service activities. It was also noted that a considerable part of faculty teaching is informally conducted, and that it takes place in the course of faculty and student research. Considerable interest was expressed in ways both administration and faculty could communicate to the public the significance of faculty research for the cultural and material benefit of state and nation. It was suggested that in addition to newspaper and radio, television can increasingly be employed to communicate the University's vital contributions.